Sibling Rivalry over Maternal Investment and its Relationship with Maternal Sleep, Postpartum Depression, and Interbirth Intervals

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Subject: Psychology

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Title: Sibling Rivalry over Maternal Investment and its Relationship with Maternal Sleep, Postpartum Depression, and Interbirth Intervals

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Abstract:
It has been proposed that infant night waking is an adaptation by which the infant exhausts the mother and increases the length of her interbirth intervals to decrease sibling rivalry over maternal investment. Based on this premise, the current study examined (i) whether maternal sleep disruption due to infant night waking is associated with increased interbirth intervals and symptoms of postpartum depression, and (ii) whether symptoms of postpartum depression mediate this association. We analyzed the associations between infant night waking, maternal sleep disruption, symptoms of postpartum depression, and interbirth intervals, using retrospective data from 729 mothers living in Finland. We conducted five structural regressions, one with the full sample, two for the oldest child at the age intervals 0 – 1 years and 1 – 3 years, and two for the second oldest child at the same age intervals. For the full sample, infant night waking was associated with maternal sleep disruption (β = .84, 95% CI [.82; .86]), and maternal sleep disruption was associated with symptoms of postpartum depression (β = .75, 95% CI [.72; .77]). Symptoms of postpartum depression were associated with longer interbirth intervals (β = .23, 95% CI [.12; .35]), and maternal sleep disruption was associated with shorter interbirth intervals (β = -.30, 95% CI [-.41; -.19.]). The results indicate that maternal sleep disruption due to infant night waking is not associated with longer interbirth intervals. Symptoms of postpartum depression are, however, associated with longer interbirth intervals. This indicates that they might play a more active role, from the offspring's perspective, in lengthening the interbirth intervals, and not just being an unintentional byproduct of the mother's sleep disruption.

Keywords: Infant Night Waking, Maternal Sleep Disruption, Postpartum Depression, Mother-offspring Conflict, Sibling Rivalry over Maternal Investment, Interbirth Intervals

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Abstrakt:
Tidigare forskning har teoriserat om ifall nattvaknande under spädbarnstiden kunde vara en adaption för att minska på syskonrivalitet om moderns investeringar genom att trötta ut modern, och på så sätt förlänga tiden tills nästa syskon föds. Baserat på denna premiss undersöktes: (i) ifall mödrars sömnproblem på grund av spädbarns nattvaknande är associerade med längre tidsintervall mellan födslar och med symtom på postpartumdepression, och (ii) om symtom på postpartumdepression medierar denna association. Associationerna mellan nattvaknande hos spädbarn, mödrars sömnproblem, symtom på postpartumdepression, och tidsintervallet mellan födslar analyserades med hjälp av retrospektivt data från 729 mödrar bosatta i Finland. Fem strukturella regressioner genomfördes, en med hela samplet, två för det äldsta barnet under två olika åldersintervall och två för det nästäldsta barnet under samma åldersintervall. Spädbarns nattvaknande associerades med mödrars sömnproblem (β = .84, 95 % CI [.82; .86]), och mödrars sömnproblem associerades med symtom på postpartumdepression (β = .75, 95 % CI [.72; .77]). Symtom på postpartumdepression associerades med längre intervall mellan födslar (β = .23, 95 % CI [.12; .35]), och mödrars sömnproblem associerades med kortare intervall mellan födslar. (β = -.30, 95 % CI [-.41; -.19]). Resultaten tyder på att mödrars sömnproblem på grund av spädbarns nattvaknande inte är associerade med längre tidsintervall mellan födslar. Symtom på postpartumdepression är däremot associerade med längre tidsintervall mellan födslar. Detta tyder på att symtom på postpartumdepression eventuellt har en mer aktiv roll i deras påverkan av längden på tidsintervallen mellan födslar, och inte endast är en oavsiktlig biprodukt av mödrars sömnproblem.

Nyckelord: Spädbarns nattvaknande, Mödrars sömnproblem, Postpartumdepression, Mödra-barn konflikt, Syskonrivalitet över moderns investeringar, Tidsintervallet mellan födslar

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Introduction

Parental investment is a term first introduced by Trivers (1972, p. 139), and defined as "any investment by the parent in an individual offspring that increases the offspring's chance of surviving (and hence reproductive success) at the cost of the parent's ability to invest in other offspring". The offspring has, in evolutionary theory, traditionally been seen as passive in relation to its parent, with the parent, metaphorically speaking, having the power to allocate resources in a way that would maximize their own fitness. Trivers (1974) originated the idea that both offspring and parent will actively seek to affect the allocation of resources, with the offspring trying to influence its parents to increase its share at the expense of its siblings. This will lead to a conflict in how to best allocate the resources to either maximize the offspring's fitness or the parent's fitness.

Mother-offspring conflict is that over maternal investment in an offspring, where the ideal investment from the offspring's fitness' point of view differs from the ideal investment from the mother's fitness' point of view (Trivers, 1974). The conflict arises from the fact that mothers share only 50% of their genes with each offspring, whereas an offspring has 100% of its own genes, and shares only 50% of its genes with each of its siblings. It is therefore better for the mother's fitness to spread her investment equally between all her current and potential future offspring in a way that increases their cumulative chance of survival. For the offspring's fitness however, a larger investment in itself compared to the investment in its siblings is beneficial.

Interbirth Intervals and Infant Night Waking

One way mother-offspring conflict might express itself is in the length of interbirth intervals (IBIs). IBIs are the time intervals between a mother's consecutive births. The optimal IBI differs from the standpoint of the mother's and the offspring's fitness, with the mother favoring shorter intervals than the offspring (Haig, 2014). This is because human females are fertile during a limited time-span, and shorter IBIs increase the mother's chances of maximizing her reproductive success, thus maximizing her fitness (Blurton Jones & da Costa, 1987). For the offspring, however, longer IBIs decrease sibling rivalry over maternal investment, benefitting the child's fitness. Nevertheless, there is a 50% chance that a gene present in the offspring will be present in the sibling as well. Therefore, in accordance with inclusive fitness theory (introduced by Hamilton, 1964, stating that altruistic behavior will determine genetic success), the optimal length of the IBI for the offspring will not be infinite. Thanks to modern healthcare, the lengths

of IBIs are no longer as predictive of offspring survival (Haig, 2014). Still, in hunter-gatherer societies, longer IBIs correlate with a reduction in mortality rates for the offspring (Blurton Jones & da Costa, 1987; Haig, 2014). For instance, for the !Kung hunter-gatherers, IBIs of two years resulted in a mortality rate of 70%, with the rate decreasing to 10% for IBIs of four years (Blurton Jones & da Costa, 1987). For the Sereer in rural Senegal, IBIs of less than two years resulted in a mortality rate of 16%, whereas for IBIs longer than two years the mortality rate was 4% (Ronsmans, 1996). In sum, longer IBIs have, on the one hand, been associated with decreased mortality rates for the offspring, being beneficial for its fitness. On the other hand, slightly shorter IBIs enable the mother to maximize her reproductive success, benefitting her fitness.

It has previously been suggested that one way an offspring might be able to influence the length of the IBI, is by waking up to breastfeed, as this could extend the length of the mother's lactational amenorrhea (Blurton Jones & da Costa, 1987). A recent study conducted by Gunst et al. (2021) hypothesized a mechanism with which the offspring could influence the length of the IBI. They suggested that night waking could be a strategy utilized by an offspring in order to influence the length of the IBI by exhausting the mother. Mothers exhausted by their offspring would be less capable of conceiving and gestating an additional offspring (De Judicibus & McCabe, 2002; White, 2016), thus delaying its birth which, in turn, would increase the length of the IBI. Their data were obtained six months postpartum, and the results of the study showed that infant night waking was associated with postpartum depression, and that this association was mediated by maternal sleep disruption.

Maternal Sleep Disruption and Postpartum Depression

That frequent infant night waking affects maternal sleep is quite unsurprising. A recent study showed that parental sleep satisfaction declines postpartum, with maternal sleep being especially affected (Richter et al., 2019). In addition, it seems that fragmented sleep enhances the experience of having a poor sleep quality (Meltzer & Mindell, 2007). Studies on adult sleep disruption have consistently showed sleep deprivation having a negative impact on mood, stress, fatigue, as well as motor and cognitive functioning (Bayer et al., 2007; Belenky et al., 2003; Dinges et al., 2005; Pilcher & Huffcutt, 1996; Van Dongen et al., 2003). Furthermore, studies have shown that the stress resulting from sleep deprivation can make people more vulnerable for mood related disorders such as dysphoria and mood lability (Bayer et al., 2007; Dinges et al.,

1997; Dinges et al., 2005; Riemann et al., 2001; Ross et al., 2005). In sum, fragmented sleep and sleep deprivation have, amongst others, a negative impact on mood, and can increase the likelihood of developing mood related disorders.

Several studies have also identified a relationship between maternal sleep disruption and postpartum depression (Bayer et al., 2007; Dennis & Ross, 2005; Karraker & Young, 2007), and in particular for mothers who report chronic night waking in their infants (Karraker & Young, 2007). According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric Association, 2013) the diagnostic criterium for postpartum depression is a major depressive disorder with peripartum onset, more specifically during pregnancy or up to four weeks postpartum. However, a meta-analysis conducted by Gavin et al. (2005) found that onset of symptoms of postpartum depression is common during the entire first year after giving birth, with a slightly higher prevalence during the second and third month. This suggests that the timeframe of only four weeks for initial depression symptoms set by the DSM-5 would not include a large proportion of mothers with symptoms of postpartum depression.

Postpartum depression, as with any major depressive disorder, is very debilitating for mothers. Studies have shown that mothers with symptoms of postpartum depression interact differently with their infants (Cohn et al., 1990; Field et al., 1985). The depressed mothers showed more negative affect and were less content while interacting with their infants, whereas the infants themselves tended to be fussier and less relaxed compared to infants of non-depressed mothers. Furthermore, postpartum depression has been shown to increase the risk of adverse cognitive, social, and emotional development for the offspring (O'Hara, 2009). In light of this, the relationship between infant night waking and postpartum depression is quite interesting. Studies have shown, that when sleep treatments for the infant have decreased infant night waking, the degree of postpartum depression symptoms for the mothers has decreased as well, indicating a causal direction between infant night waking and symptoms of postpartum depression (Armstrong et al., 1998; Hiscock & Wake, 2001). This suggests that more frequent infant night waking increases the symptoms of postpartum depression, which, considering postpartum depression can be harmful for the infant as well as for the mother, is perplexing.

Bearing in mind the negative impact postpartum depression has for both the mother and the offspring, it is from an evolutionary perspective hard to grasp why it is so prevalent, affecting up to 15% of mothers (Gavin et al., 2005). Yet, if infant night waking is an adaptation to increase

the length of IBIs by exhausting the mother, then postpartum depression could be an unintentional byproduct of this behavior (Gunst et al., 2021). Alternatively, postpartum depression could be adaptive from the offspring's fitness' point of view, if it makes the mother less able to conceive and gestate an additional offspring (De Judicibus & McCabe, 2002; White, 2016), lengthening the IBI.

The Current Study

Based on the premise that infant night waking is an adaptation to increase IBIs by exhausting the mother, as well as building on the association between infant night waking and postpartum depression, we examined whether maternal sleep disruption due to infant night waking is associated with longer IBIs and symptoms of postpartum depression. The following hypotheses were tested:

1. Infant night waking will positively correlate with maternal sleep disruption.
2. Maternal sleep disruption will positively correlate with symptoms of postpartum depression.
3. Maternal sleep disruption will correlate with longer interbirth intervals. Here, we further explored whether the relationship between maternal sleep disruption and interbirth intervals will be mediated by symptoms of postpartum depression.

Method

Ethical Statement

The current study was granted ethical permission by the Board for Research Ethics at Åbo Akademi University before data collection began. All participants gave their informed consent prior to participating in the study.

Participants

We sampled mothers between 18 and 60 years old, with at least two biological children. Mothers of twins were excluded from the study. The participants were recruited through a Facebook advertisement targeting female adults living in Finland. Participants who did not respond to all items in the questionnaire were excluded from the statistical analyses. The completion rate for the survey was 64.0%. The final sample consisted of 729 mothers, aged 22 to 60 years old, with a mean age of 41.3 years (SD = 9.2).

Procedure

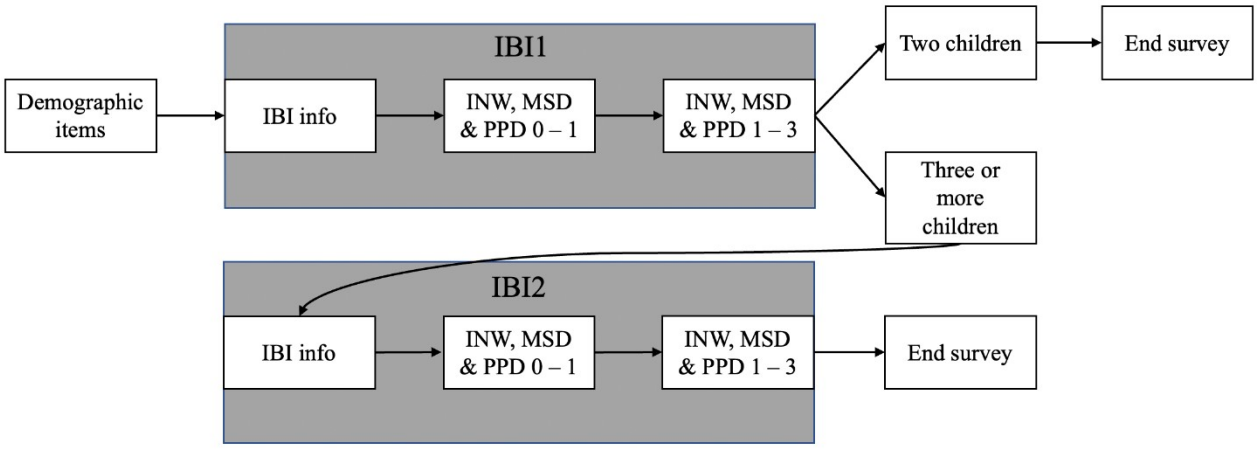
Our survey was created through a secure online survey platform. The data collection began early April 2020 and lasted for five days. The recruitment advertisement on Facebook reached 50,425 Facebook-users. All participants were asked to give their informed consent, and they were informed that participation is voluntary and that they can terminate their participation at any point during the survey. They were also told that all data will be reported at group-level, hence individual results will be kept anonymous.

All participants were asked to provide some demographic information as well as descriptive information regarding the IBIs, consisting of questions about breastfeeding, use of contraceptives, miscarriage, abortion and in-vitro fertilization (IVF). Mothers of two children answered the measures mentioned below for the first IBI (i.e., the period of time between the first and the second birth). The measures were asked twice, for two age intervals, namely the child's first year and when the child was between 1 and 3 years old. Mothers of three or more children answered the same measures but for the first two IBIs (i.e., the period of time between the first and second birth as well as the period of time between the second and third birth). For the first IBI, the mother answered according to how it was when the oldest child was 0 to 1 years and 1 to 3 years old. For the second IBI the mother answered according to how it was when her second oldest child was 0 to 1 years and 1 to 3 years old. Figure 1 visualizes the survey layout.

After completing the survey, all participants were invited to a separate questionnaire where they could fill in their e-mail address in order to participate in a lottery of a 100€ gift card to a multi-brand online shop.

Figure 1

Survey Layout.



Note. Model representing the survey layout. IBI = Interbirth interval. INW = Infant night waking. MSD = Maternal sleep disruption. PPD = Symptoms of postpartum depression. IBI1 = IBI between the oldest and second oldest child; IBI2 = IBI between the second oldest and third oldest child. Demographic items = Questions regarding demographic information. IBI info = Descriptive information regarding the IBIs, regarding breastfeeding, use of contraceptives, miscarriage, abortion and in-vitro fertilization. INW, MSD & PPD 0 – 1 = Measures for INW, MSD and PPD for the first studied age interval (when the child was between 0 and 1 years old). INW, MSD & PPD 1 – 3 = Measures for INW, MSD and PPD for the second studied age interval (when the child was between 1 and 3 years old). For the first IBI, the mother reported INW for the oldest child, and MSD and PPD for how she was feeling when her oldest child was 0 – 1 years and 1 – 3 years old. For the second IBI the mother reported INW for the second oldest child, and MSD and PPD for how she was feeling when her second oldest child was 0 – 1 years and 1 – 3 years old.

Measures

Infant night waking. To measure the frequency of infant night waking, three self-made questions were used (see appendix for original items). The items were rated on a 5-point Likert scale (1 – 5), with the anchors 1 = *no problem*; 5 = *very severe problem*.

Maternal sleep disruption. To measure the level of maternal sleep disruption, the Insomnia Severity Index (ISI; Morin, 1993) was used. The ISI is a considered a valid and reliable self-report questionnaire consisting of seven items that are designed to determine the severity of insomnia related issues taking place during the night as well as during the day (Bastien et al., 2001). Each item on the index is rated on a 5-point Likert Scale (0 – 4), with the anchors 0 = *no problem*; 4 = *very severe problem*. The total scores on the index ranges from 0 to 28, with scores of 0 to 7 indicating absence of insomnia, 8 to 14 sub-threshold insomnia, 15 to 21 moderate insomnia, and 22 to 28 severe insomnia (Morin et al., 2011). In addition to the ISI, one self-made

question measuring average hours of sleep was used (see appendix for items).

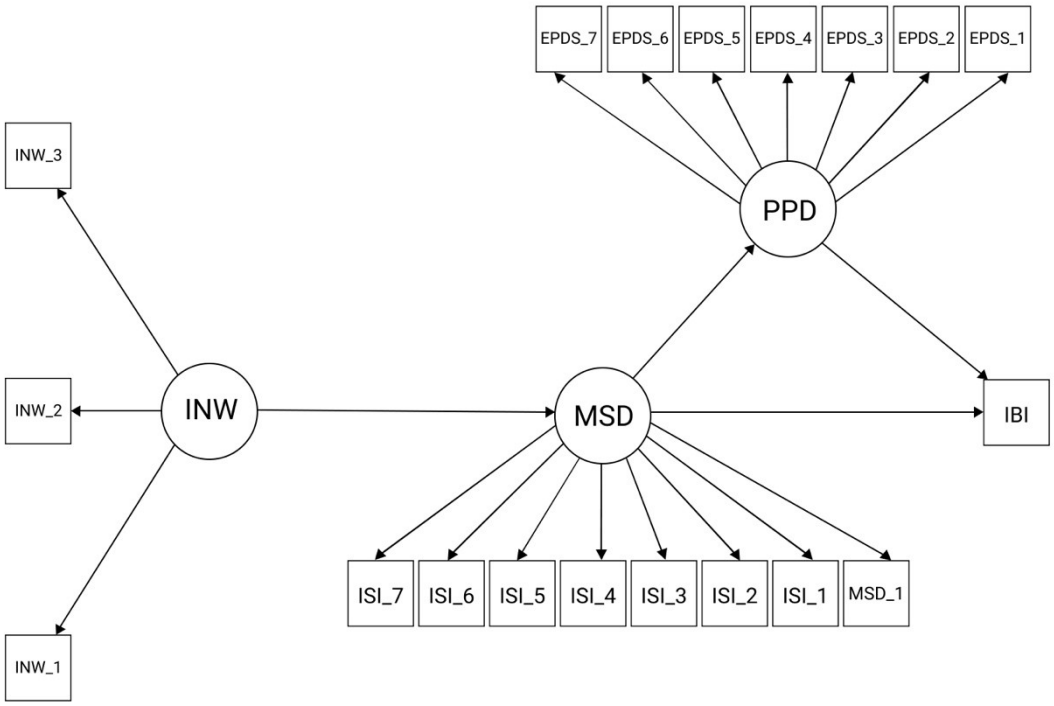
Postpartum depression. To measure symptoms of postpartum depression, the seven-item short version of the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; Gollan et al., 2017) was used (see appendix for items). The original version is a standardized self-report questionnaire consisting of 10 items assessing the components of postpartum depression during and after pregnancy (Cox et al., 1987). The seven items that were used for this study (items 1, 2, 6, 7, 8, 9, 10) focus solely on measuring symptoms of depression, with the three excluded items measuring anxiety (Gollan et al., 2017). Each item on the scale is rated on a 4-point Likert Scale (0 – 3) with the total score ranging from 0 to 21. A higher total score indicates more depressive symptoms, with scores above eight having been suggested as a threshold for depression.

Statistical Analyses

All of our statistical analyses were done in *R* (version 3.5.0; R Core Team, 2018), utilizing the *lavaan* package (Rosseel, 2012) for the structural regressions and the *corrplot* package (Wei & Simko, 2017) for visualizing the correlations between items. As a preliminary step we analyzed data descriptives and correlations with sum scores. For the regressions we used latent variables. We conducted a structural equation model, adjusting for measurement error. IBI was regressed on the latent factors maternal sleep disruption and symptoms of postpartum depression. Symptoms of postpartum depression was regressed on maternal sleep disruption, and maternal sleep disruption on the latent factor infant night waking. Figure 2 visualizes the regressions. We conducted five structural regressions, one with the full sample (i.e., both children at both age intervals), and two for the oldest child, at the age intervals 0 to 1 years and 1 to 3 years, as well as two for the second oldest child, at the same age intervals. For the two structural regressions conducted at the age interval 1 to 3 years, we removed the participants that had had an additional child within three years of the child in question. We removed these participants to make sure that another infant did not influence the measures infant night waking, maternal sleep disruption and symptoms of postpartum depression except the child in question (i.e., the oldest child for the first IBI and the second oldest child for the second IBI). Additionally, we analyzed the sample with winsorized IBIs to explore whether any outliers influenced the results. No participants were removed from the analyses, but the length of the 5% longest IBIs were changed to 101 months.

Figure 2

Model Visualizing the Structural Regressions



Note. Model of the structural regressions. INW = Infant night waking. MSD = Maternal sleep disruption. PPD = Symptoms of postpartum depression. IBI = Interbirth interval. EPDS = seven-item short version of the Edinburgh Postnatal Depression Scale (Cox et al., 1987; Gollan et al., 2017). ISI = Insomnia Severity Index (Morin et al., 2011). The standardized regression coefficients, the residual correlations between variables and the residual variance of the individual variables are not visualized. IBI is being regressed on the latent factors indicating symptoms of postpartum depression and maternal sleep disruption, symptoms of postpartum depression are regressed on maternal sleep disruption, and maternal sleep disruption is regressed on the latent factor infant night waking. The latent factors are represented by circles, whereas their indicators and the separate item for IBI are represented by squares.

Results

Descriptive Results

Descriptive statistics of the sample are presented in Table 1.

Table 1

Sample Descriptives

Variables	*n*	*%*
Oldest child's sex		
Female	358	49.1
Male	368	50.5
Other	3	0.4
Second oldest child's biological sex		
Female	347	47.6
Male	379	52.0
Other	3	0.4
Third oldest child's biological sex		
Female	141	47.6
Male	155	52.4
Other	0	0
Relationship status		
Married/cohabiting with (one of) the children's biological father	545	74.8
In a relationship with (one of) the children's biological father	5	0.7
Married/cohabiting with someone other than the children's biological father	42	5.8
In a relationship with someone other than the children's biological father	47	6.4
Single	90	12.3
Same biological father[a]		
All of the children	611	83.9
Oldest and second oldest child, not third oldest child	32	4.4
Second oldest and third oldest child, not oldest child	32	4.4
Oldest and third oldest child, not second oldest child	1	0.1
None of the children	52	7.1
Breastfeeding[b]		
Oldest child	660	90.5
Second oldest child	286	96.6
Use of contraceptives[b]		
First IBI	416	57.1
Second IBI	163	55.1
Miscarriage[b]		
First IBI	118	16.2
Second IBI	41	13.9
Abortion[b]		

Variables	*n*	*%*
First IBI	22	3.0
Second IBI	12	4.1
IVF		
IVF for first child	21	2.9
IVF for second child	18	2.5
IVF for third child	8	2.7[c]
IVF for any of the children	31	4.3

Note. $N = 729$ ($n = 296$ for mothers with three or more children). IBI = Interbirth Interval. IVF = In-Vitro Fertilization.

[a] One participant's response was excluded due to an illogical answer ($N = 728$; $n = 295$ for mothers with three or more children). [b] Reflects the number and percentage of participants who answered yes to this question. [c] Represents the percentage of mothers with three or more children ($n = 296$).

Of the participating mothers ($N = 729$), 433 had two children, 296 had three or more. The mean, in months, for the first IBI was 39.9 ($N = 729$, $SD = 29.1$), and 46.4 for the second IBI ($n = 296$, $SD = 33.5$). For the mothers who breastfed their oldest child ($n = 660$), the mean of the duration was 11.0 months ($SD = 7.7$). For the second child, the mean was 11.5 months ($n = 286$, $SD = 7.6$). Of the participants who had a miscarriage during their first IBI ($n = 118$), the mean number of miscarriages was 1.3 ($SD = 0.9$). For the second IBI, the mean was 1.2 ($n = 41$, $SD = 0.5$).

Means for the different children and age groups for the composite variables indicating infant night waking, maternal sleep disruption, and symptoms of postpartum depression illustrate mean levels for the sum variables and are presented in Table 2. The regressions use latent variables, taking measurement error into account.

Table 2

Means for the Different Children and Age Groups for the Composite Variables Infant Night Waking, Maternal Sleep Disruption and Symptoms of Postpartum Depression

	M	SD
Infant night waking		
Oldest child, age 0 – 1	9.1	3.5
Oldest child, age 1 – 3	6.3	2.8
Second child, age 0 – 1	8.9	3.3
Second child, age 1 – 3	6.8	3.2
Maternal sleep disruption		
Oldest child, age 0 – 1	19.9	7.8
Oldest child, age 1 – 3	15.5	6.5
Second child, age 0 – 1	22.4	7.9
Second child, age 1 – 3	19.8	7.3
Postpartum depression		
Oldest child, age 0 – 1	5.2	4.5
Oldest child, age 1 – 3	4.2	4.1
Second child, age 0 – 1	5.1	4.6
Second child, age 1 – 3	4.2	4.1

Note. Higher scores indicate more infant night waking, maternal sleep disturbance and more symptoms of postpartum depression respectively. To measure infant night waking, we used three self-constructed questions with the range 3 – 15. For measuring maternal sleep disruption, we used one self-constructed question, as well as the Insomnia Severity Index (Morin et al., 1993) with the range 0 – 28. For the self-constructed question, that measured average hours of sleep, we reversed the score so that more hours of sleep indicated less sleep problems. We allowed a maximum of 12h in average of sleep, and changed the outliers (more than 12h in average of sleep) to 12, giving it a range of 0 – 12. Thus, the final range for maternal sleep disruption was 0 – 40. To measure symptoms of postpartum depression, we used the seven-item short version of the Edinburgh Postnatal Depression Scale (Cox et al., 1987; Gollan et al., 2017), with the range 0 – 21.

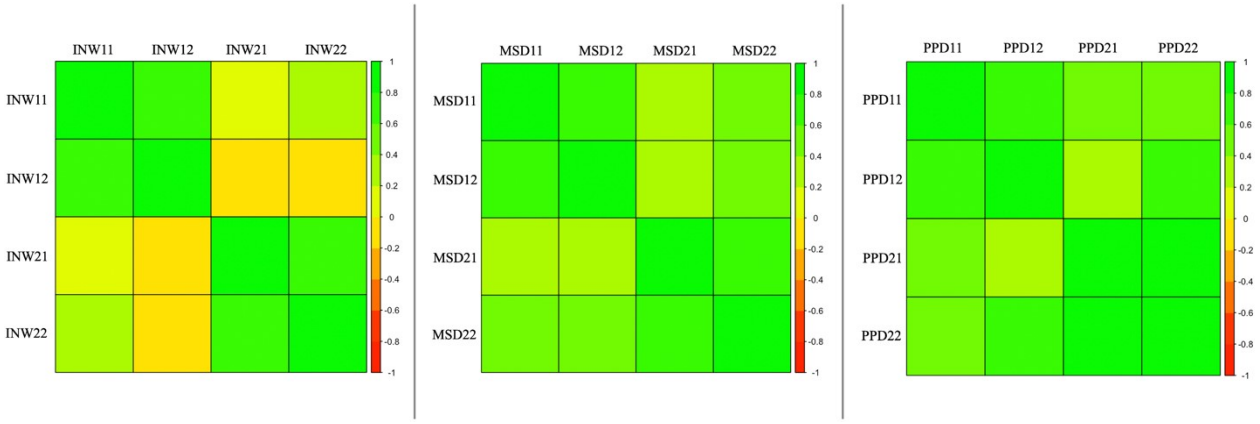
Correlations

Zero-order correlations of the composite variables indicating infant night waking, maternal sleep disruption and symptoms of postpartum depression are shown in Figure 3. We used Spearman correlations since the data was ordinal. For all the composite variables, the cross-time, within-subject (i.e., same child during the two age intervals) correlations were strong and positive. The within-time, between-subject (i.e., both children during the same age interval) correlations for maternal sleep disruption and symptoms of postpartum depression were also

positive. For infant night waking however, the correlations between the oldest child at the second age interval (age 1 – 3) and the second oldest child at both age intervals were negative. For the first age interval for the oldest child, the within-time, between-subject correlations were positive. The correlations for the individual variables can be found in the appendix.

Figure 3

Plots of the Zero-order Correlations of the Composite Study Variables



Note. Plots of the zero-order correlations for the composite variables indicating infant night waking, maternal sleep disruption and symptoms of postpartum depression. Strong positive correlations are shown in green, whereas strong negative correlations are shown in red. Correlations close to zero are shown in yellow. The first number following the abbreviation stands for either the oldest child (= 1) or the second oldest child (= 2), with the second number representing the age interval in question (1 = 0 – 1 years, 2 = 1 – 3 years). INW = Infant night waking. MSD = Maternal sleep disruption. PPD = Symptoms of postpartum depression.

Results from the Structural Regression Model

Measurement model. We specified a model with three latent variables, *Infant Night Waking* (three indicators), *Maternal Sleep Disruption* (eight indicators) and *Symptoms of Postpartum Depression* (seven indicators). For the measurement model, both the oldest and the second oldest child at both age intervals (age 0 – 1, and 1 – 3) were included. Our initial model showed suboptimal fit (χ^2 [132] = 2171.165, $p < .001$, CFI = .975, TLI = .971, RMSEA = .104 [.100, .108], SRMS = .052), so we adjusted the model to improve the fit by adding five residual correlations, all within scales. The residual correlations allowed increased χ^2 fit with at least 50 points. Two of the residual correlations were between EPDS items, namely items 1 and 2, measuring the mother's ability to see the funny side of things and ability to enjoy future events, as well as items 5 and 6, measuring the mother's level of misery and unhappiness. Three of the

residual correlations were between ISI items. Items 1 and 2, measuring problems falling and staying asleep, items 2 and 3, measuring problems staying asleep and waking up too early and items 1 and 3, measuring problems falling asleep and waking up too early. After the above-mentioned adjustments, our final model showed adequate fit (χ^2 [127] = 1254.443, $p < .001$, CFI = .986, TLI = .983, RMSEA = .079 [.075, .083], SRMS = .042).

Structural regressions. We conducted five structural regressions. First, one using the full sample, more specifically both children at both age intervals (n = 1429). Second, four separate regressions for both children at both age intervals. For the structural regressions, we assumed that infant night waking would be positively associated with maternal sleep disruption, and that maternal sleep disruption in turn would be associated with symptoms of postpartum depression and increased IBIs. Furthermore, we explored whether or not the hypothesized association between maternal sleep disruption and increased IBIs was mediated by symptoms of postpartum depression. The results of the five analyses are summarized in Table 3. The analyses were conducted using the above-mentioned adjusted model. The results for the full sample showed that infant night waking was associated with maternal sleep disruption (β = .84), and maternal sleep disruption was associated with symptoms of postpartum depression (β = .75). Symptoms of postpartum depression were associated with longer IBIs (β = .23), whereas maternal sleep disruption was associated with shorter IBIs (β = -.30). In line with the full sample regression, the results for the separate structural regressions showed that infant night waking was associated with maternal sleep disruption for both children at both age intervals (β = .84; β = .78; β = .82; β = .81). Maternal sleep disruption was also associated with symptoms of postpartum depression for both children at both age intervals (β = .74; β = .69; β = .78; β = .81). Interestingly, symptoms of postpartum depression were associated with longer IBIs for the oldest child during both age intervals (β = .23; β = .28) but was not significantly associated with IBIs for the second oldest child at either age interval. Finally, maternal sleep disruption was associated with shorter IBIs for the oldest child at both age intervals (β = -.22; β = -.30), but not significantly associated with IBIs for the second oldest child at both age intervals.

Table 3

Results from the Structural Regression Models

	n			*b*	β	95% CI[a]	*SE*	*z*	*p*
Full sample	1429	INW	MSD	0.69	.84	[.82; .86]	0.01	48.58	<.001
		MSD	PPD	0.92	.75	[.72; .77]	0.02	38.14	<.001
		PPD	IBI	8.64	.23	[.12; .35]	2.13	4.06	<.001
		MSD	IBI	-13.49	-.30	[-.41; -.19]	2.60	-5.20	<.001
Total effect				-5.58	-.12	[-.18; -.07]	1.28	-4.37	<.001
Indirect effect				7.92	.17	[.09; .26]	1.96	4.03	<.001
Oldest child, 0 – 1	729	INW	MSD	0.69	.84	[.82; .87]	0.02	33.69	< .001
		MSD	PPD	0.90	.74	[.70; .78]	0.04	24.67	< .001
		PPD	IBI	7.67	.23	[.08; .38]	2.54	3.02	.003
		MSD	IBI	-8.68	-.22	[-.37; -.06]	3.15	-2.75	.006
Total effect				-1.80	-.05	[-.12; .04]	1.63	-1.11	.269
Indirect effect				6.88	.17	[.06; .28]	2.30	2.99	.003
Oldest child, 1 – 3	267	INW	MSD	0.62	.78	[.74; .83]	0.04	17.51	< .001
		MSD	PPD	0.83	.69	[.62; .76]	0.06	12.97	< .001
		PPD	IBI	11.15	.28	[.05; .51]	4.69	2.38	.017
		MSD	IBI	-14.45	-.30	[-.53; -.07]	5.71	-2.53	.011
Total effect				-5.15	-.11	[-.23; .02]	3.11	-1.65	.098
Indirect effect				9.30	.19	[.04; .35]	3.92	2.37	.018
Second child, 0 – 1	296	INW	MSD	0.68	.82	[.79; .86]	0.03	23.41	< .001
		MSD	PPD	1.01	.78	[.73; .84]	0.05	20.02	< .001
		PPD	IBI	-1.68	-.05	[-.29; .20]	4.38	-0.38	.701
		MSD	IBI	3.02	.07	[-.17; .30]	5.46	0.55	.581
Total effect				1.32	.03	[-.09; .15]	2.67	0.49	.621
Indirect effect				-1.70	-.04	[-.23; .15]	4.41	-0.38	.701
Second child, 1 – 3	137	INW	MSD	0.56	.81	[.74; .87]	0.05	12.32	< .001
		MSD	PPD	1.15	.81	[.76; .87]	0.09	12.78	< .001
		PPD	IBI	9.89	.27	[-.09; .64]	6.70	1.48	.140
		MSD	IBI	-13.09	-.25	[-.63; .12]	9.95	-1.32	.188
Total effect				-1.70	-.03	[-.21; .15]	4.74	-0.36	.720
Indirect effect				11.40	.22	[-.08; .52]	8.02	1.42	.156

Note. INW = Infant night waking; MSD = Maternal sleep disruption; PPD = Symptoms of postpartum depression; IBI = Interbirth interval.

[a] Confidence interval reported for the standardized beta coefficient.

The total effect of maternal sleep disruption (either mediated through symptoms of postpartum depression or alone) was also significant and negative for the full sample (β = -.12), but not for any of the separate regressions. The indirect effect, meaning the proportion of the association between maternal sleep disruption and IBIs that is mediated by symptoms of postpartum depression, was significant for the full sample (β = .17) and for the oldest child during the first year (β = .17), but not for the other children at either age interval.

To explore whether any outliers significantly influenced the results of the five analyses, we further analyzed the sample with winsorized IBIs, by limiting the 5% longest IBIs, making the maximum IBI allowed 101 months. The results of the winsorized structural regressions showed that the results were not influenced by any outliers and are shown in the appendix.

Discussion

Our objective with the current study was to examine whether infant night waking, in accordance with the theory of mother-offspring conflict, could be an adaptation to debilitate the mother in order to influence the length of the interbirth interval (IBI), thus limiting sibling rivalry over maternal investment. According to this theory, infant night waking is a strategy by which the offspring could influence the length of the IBI by exhausting the mother, thus, making her less capable of conceiving and gestating an additional child too soon (from the offspring's fitness' point of view). We further explored whether symptoms of postpartum depression could be an unintentional byproduct due to the maternal sleep disruption caused by the infant's night waking, or if it would actually mediate the association between maternal sleep disruption and IBIs. This would mean that postpartum depression, which is a disorder that is difficult to explain from an evolutionary standpoint, could either be viewed as a byproduct of the infant's adaptive behavior to tire the mother, or in fact be viewed as adaptive from the offspring's point of view.

Main Findings and Interpretations

First, and perhaps not surprisingly, we found that infant night waking predicted more maternal sleep disruption. This is in line with previous research on the relationship (Bayer et al., 2007; Burnham et al., 2002), and fits the theorized causal model which suggests that having an infant that frequently wakes during the night has a negative impact on the mother's sleep, even though this study did not test for causality. Furthermore, we found that maternal sleep disruption predicted more symptoms of postpartum depression, indicating that more severe sleep problems for the mother are associated with a higher frequency of symptoms of postpartum depression.

Previous research (Bayer et al., 2007; Dennis & Ross, 2005; Karraker & Young, 2007), has established this association, especially for mothers with infants who wake up often during the night. The causal direction of this association is not clear. Changes in sleep patterns are a common symptom of a major depressive disorder (American Psychiatric Association, 2013). Nevertheless, research also suggests that having a poor sleep quality is a risk factor for developing a mood disorder (Bayer et al., 2007; Dinges et al., 1997; Dinges et al., 2005; Riemann et al., 2001; Ross et al., 2005). It is, therefore, possible that the results of the regressions are due to symptoms of postpartum depression causing the increased sleep problems, alternatively that sleep problems make mothers more prone to develop symptoms of postpartum depression. Still, previous research has found that when sleep treatments for the infant decrease the number of night wakings, symptoms of postpartum depression for the mother have decreased as well (Armstrong et al., 1998; Hiscock & Wake, 2001). This lends support to the notion that increased sleep problems make mothers more prone to develop symptoms of postpartum depression.

Contrary to our hypothesis, we found that maternal sleep disruption predicted shorter IBIs in the full sample, and for the oldest child during both age intervals. Interestingly, there was no significant association between maternal sleep disruption and IBIs for the second oldest child during the same age intervals. This indicates that when mothers suffer from more severe sleep problems, but not from symptoms of postpartum depression, it is associated with shorter IBIs between the birth of the oldest and second oldest child, but not between the birth of the second and third oldest child. These results are contradictory to our initial predictions, where we hypothesized that symptoms of postpartum depression could be an unintentional byproduct of the infant's adaptive behavior to exhaust their mother in order to lengthen the IBI. A potential reason for this association could be received social support, and more specifically support from the mother's partner. Previous research has theorized that postpartum depression could be a way a woman signalizes the need for additional social support (Hagen, 1999). It is possible that mothers who are sleep deprived, but do not develop symptoms of postpartum depression already receive adequate social support. Furthermore, it is more likely they have access to a supportive partner, facilitating the conception of an additional child. In other words, a speculative way the results of the association between maternal sleep disruption and IBIs might be interpreted, is that mothers who are sleep deprived but do not develop symptoms of postpartum depression receive more

social support. This support would protect mothers from developing a depressive mood, and further enable them to conceive and gestate an additional child, thus, shortening the IBI.

Symptoms of postpartum depression predicted longer IBIs for the full sample, and for the oldest child at both age intervals. There was not a significant association between symptoms of postpartum depression and IBIs for the second oldest child at either of the age intervals. This indicates that when mothers experience symptoms of postpartum depression during their oldest child's first three years, they are more likely to have a longer IBI between the birth of the oldest and second oldest child. These results support the notion that symptoms of postpartum depression in and of itself could be viewed as adaptive from the offspring's fitness' point of view, since more severe symptoms of postpartum depression are associated with longer IBIs.

Furthermore, the indirect effect of maternal sleep disruption on IBIs via symptoms of postpartum depression indicate that symptoms of postpartum depression indeed mediate part of the association between maternal sleep disruption and IBIs for the full sample and for the oldest child during the first age interval. However, the total effect of maternal sleep disruption, either mediated through symptoms of postpartum depression or alone, on IBIs is still significant and negative for the full sample. This indicates that when symptoms of postpartum depression mediate the association between maternal sleep disruption and IBIs, maternal sleep disruption still predicts shorter IBIs. The current study used only retrospective data. Thus, a speculative interpretation of these results is that it is possible that mothers who had children in quick succession remember the first years of childhood as a time in their life when they were constantly tired. Hence, the memory of being constantly tired could make it more likely that they report more severe maternal sleep disruption.

Finally, the results imply that there is a difference between mothers of two and mothers of three or more children. For both the associations between maternal sleep disruption and IBIs as well as for symptoms of postpartum depression and IBIs the results do not show any significant associations for the second oldest child during both age intervals. The average age to give birth for first time mothers in Finland was 29.3 years in 2018 (Terveyden ja hyvinvoinnin laitos; THL, 2020). This is relatively late, considering the human female's fertility markedly decreases after 32 years of age (Committee on Gynecologic Practice of American College of Obstetricians and Gynecologists, & Practice Committee of American Society for Reproductive Medicine, 2008). In light of the high age for first time mothers in Finland, mothers who want three or more

children are forced to have them in a relatively rapid succession due to the decrease in fertility. Therefore, a speculative interpretation of the difference between these two groups of mothers is built upon the fact that mothers in Finland are relatively old when they give birth to their first child. A woman living in Finland who wishes to have more than two children would, due to the decrease in her fertility, be forced to have them relatively close to each other. This could mean that the mother's cognitions simply are stronger than any evolutionary drive to increase the IBI, providing a potential explanation for the nonsignificant results for the second IBI.

Strengths and Limitations of the Study

This study is, to the best of our knowledge, the first to examine whether postpartum depression could either be viewed as a byproduct of the offspring's adaptive behavior to tire the mother, or as adaptive from the offspring's fitness' point of view by increasing the length of the IBI. This is an attempt to find an evolutionary sound theory as to why postpartum depression, a disorder with severe adverse implications for both mother and offspring, exists.

The study design had several strengths. To collect the data, we used two, well-validated questionnaires, namely the seven-item short version of the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; Gollan et al., 2017), and the Insomnia Severity Index (ISI; Morin, 1993). An additional strength of the current study was the large sample, consisting of 729 mothers. The sample size enabled us to analyze the collected data using a structural equation model, SEM. SEMs take measurement error into account, and is in and of itself a strength of this study (Tomarken & Waller, 2005).

The study had several limitations. For the full sample analysis, there were issues with dependency, due to the fact that multiple observations from the same object were used. We took this into account by conducting four separate structural regressions, one for each of the studied children at each studied age interval. An alternative way of taking the dependency issues into account, would have been by conducting a multilevel structural equation model for the full sample analysis (Mehta & Neale, 2005). All measurements used consisted of retrospective, self-report questions, increasing the risk of under- or over estimation of symptoms and behaviors. The high, positive correlations across-time and within-subject possibly indicates that it was hard for mothers to differentiate between the different age intervals, for example they remember they suffered from sleep problems or symptoms of depression when their child was young, but they were not able to remember at what point in time they started sleeping or feeling better.

Furthermore, one of the inclusion criteria for participating in the current study was having at least two, biological children. This criterion excluded all mothers that for instance due to having had such severe postpartum depression or maternal sleep disruption with their first child decided to not have any additional children. In order to analyze the effects of the latent variables on the second age interval (1 – 3), all mothers who had an IBI shorter than three years were excluded from the analysis. This means that mothers who actually had a relatively short IBI are not represented in the analysis, skewing the results in favor of longer IBIs. Additionally, the sample size for these analyses was smaller, potentially resulting in issues with statistical power (Cohen, 1992). Finally, the participants in our study were in large part recruited via a Facebook ad targeting women living in Finland, making it probable that a large part of our sample consisted of mothers living in Finland. There are certain factors that are unique for mothers in Finland, for instance generous social support such as long maternity leave being available to them (Pronzato, 2009). This makes Finnish mothers slower to return to work compared to other European countries. These factors reduce the generalizability of the results.

Conclusions

Contrary to our initial hypothesis, we did not find support for the notion that infant night waking is an adaptive strategy in order to tire the mother, making her less capable of conceiving and gestating an additional child, thus lengthening the IBI. Interestingly, the results indicate that symptoms of postpartum depression, however, could themselves be adaptive from the offspring's fitness' point of view, by being associated with longer IBIs. Future research should investigate the role of maternal social support to shed light on potential explanations as to why mothers suffering from sleep disruption have shorter IBIs. Furthermore, investigation into the difference between mothers of two and mothers of three or more children is needed in order to understand why some of our results were significant only for the first IBI.

Summary in Swedish – Svensk sammanfattning

Syskonrivalitet om moderns investeringar och förhållandet mellan mödrars sömn, postpartumdepression och tidsintervallet mellan födslar

Studiens syfte

Teorin om mödra–barn-konflikt berör konflikten om hur modern fördelar sina resurser mellan sina barn (Trivers, 1974). Konflikten uppstår på grund av att den ideala investeringen i ett barn evolutionärt sett skiljer sig ur barnets respektive moderns perspektiv. Den härstammar ur det faktum att mödrar delar endast 50 % av sina gener med vart och ett av sina barn, medan barnet har 100 % av sina egna gener. Det är därför bättre för modern att balansera sina investeringar mellan hennes nuvarande samt potentiella framtida barn på så sätt att investeringarna maximerar barnens kumulativa överlevnadsmöjlighet. Barnet föredrar däremot en större investering i sig själv jämfört med investeringar i syskon.

Ett sätt mödra–barn-konflikt kan ta sig uttryck på är genom längden på tidsintervallen mellan en mors på varandra följande födslar (eng. Interbirth interval; IBI). Den optimala längden på dessa intervall skiljer sig åt beroende på om man beaktar dem ur barnets eller moderns perspektiv (Haig, 2014). För modern är det evolutionärt sett bättre med aningen kortare intervall, eftersom kvinnor är fertila under en begränsad period och på så sätt ökar de möjligheten till att maximera sin reproduktiva framgång (Blurton Jones & da Costa, 1987). För barnet är däremot aningen längre intervall evolutionärt sett bättre då de minskar syskonrivaliteten om moderns investeringar och historiskt sett förknippas med lägre dödlighet för barnet.

Tidigare forskning har antagit att amning är ett verktyg som barn kan tänkas använda sig av för att förlänga tidsintervallet mellan födslar (Blurton Jones & da Costa, 1987). Gunst et al. (2021) har framtagit en teori om ytterligare ett verktyg barnet kan tänkas använda sig av, nämligen själva nattvaknandet. De antar att nattvaknande kunde vara en adaption för att trötta ut modern så att hon är mindre kapabel att bli gravid med ytterligare ett barn och på så sätt öka längden på tidsintervallet mellan födslar.

Sömnbrist kan ha förödande konsekvenser för personer som lider av det, och forskning visar att dessa personer även löper en större risk att utveckla förstämningssyndrom (Bayer et al., 2007; Dinges et al., 1997; Dinges et al., 2005; Riemann et al., 2001; Ross et al., 2005). Vidare har ett flertal studier påvisat ett samband mellan sömnbrist hos mödrar och postpartumdepression (Bayer et al., 2007; Dennis & Ross, 2005; Karraker & Young, 2007).

Postpartumdepression är ett depressivt tillstånd som uppstår upp till ett år postpartum (American Psychiatric Association, 2013). Förutom att det är otroligt påfrestande för modern har forskning visat att postpartumdepression även förknippas med en ogynnsam utveckling för barnet (Cohn et al., 1990; Field et al., 1985). Med tanke på den negativa inverkan postpartumdepression har på både modern och barnet är det svårt att, ur ett evolutionsmässigt perspektiv, förstå hur det kommer sig att det är så prevalent, och berör upp till 15 % av mödrar (Gavin et al., 2005). Ifall nattvaknande hos spädbarn skulle vara en adaption för att förlänga tidsintervallet mellan födslar genom att trötta ut modern, skulle postpartumdepression kunna tänkas vara en oavsiktlig biprodukt av detta i övrigt adaptiva beteende (Gunst et al., 2021). Alternativt kunde nattvaknande vara adaptivt om det genom att öka moderns sömnbrist även ökar risken för att utveckla postpartumdepression, och på så sätt gör modern mindre benägen att ta hand om ett till barn, vilket i sin tur skulle förlänga tidsintervallet mellan födslar.

Baserat på premissen att nattvaknande hos spädbarn är en adaption för att trötta ut mödrar och på så sätt förlänga tidsintervallet mellan födslar, samt genom att bygga vidare på sambandet mellan nattvaknande och postpartumdepression, undersöktes i denna studie följande: (i) ifall moderns sömnbrist, på grund av barnets nattvaknande, associeras med längre tidsintervall mellan födslar och med symtom på postpartumdepression, och (ii) ifall symtom på postpartumdepression medierar associationen mellan mödrars sömnbrist och längre tidsintervall mellan födslar.

Metod

Studiens data samlades in med hjälp av en nätenkät som riktade sig till mödrar i åldern 18 till 60, med åtminstone två biologiska barn. De deltagare som inte svarade på enkätens samtliga frågor uteslöts ur de statistiska analyserna. Det slutgiltiga samplet bestod av 729 mödrar.

För att samla in data om spädbarns nattvaknande används tre egenformulerade frågor. Vidare användes frågeformuläret Insomnia Severity Index (ISI; Morin, 1993) samt en egenformulerad fråga för att samla in data om mödrars sömnproblem. Slutligen användes sju frågor ur frågeformuläret Edinburgh Postnatal Depression Scale (EPDS; Cox, 1987; Gollan et al., 2017) för att samla in data om symtom på postpartumdepression.

Ovanstående frågeformulär ställdes till samtliga av enkätens deltagare två gånger. Först hänvisade frågorna till modern och hennes äldsta barn, när barnet var i åldern 0 – 1, sedan till modern och hennes äldsta barn, när barnet var i åldern 1 – 3. Dessa frågor hänförde sig till det

första tidsintervallet mellan födslar, tidsintervallet mellan födseln av moderns äldsta och nästäldsta barn. För de deltagare som hade fler än två barn ställdes ovanstående frågeformulär två gånger till. Denna gång hänvisade frågorna till modern och hennes nästäldsta barn, under samma åldersintervall som för det äldsta barnet. Dessa frågor hänförde sig till det andra tidsintervallet mellan födslar, tidsintervallet mellan födseln av moderns nästäldsta och tredje äldsta barn.

För att analysera studiens data användes en strukturell ekvationsmodell (eng. Structural equation model; SEM). I de strukturella regressionerna regrederades tidsintervallet mellan födslar på de latenta variablerna mödrars sömnproblem och symtom på postpartumdepression. Symtom på postpartumdepression regrederades på mödrars sömnproblem, och mödrars sömnproblem regrederades på den latenta variabeln spädbarns nattvaknande. Samtliga analyser utfördes i programmet R (version 3.5.0; R Core Team, 2018).

Resultat

I tabell 1 presenteras de deskriptiva resultaten. För att analysera studiens data, specifierades en SEM-modell med tre latenta variabler, spädbarns nattvaknande (tre indikatorer), mödrars sömnproblem (åtta indikatorer) och symtom på postpartumdepression (sju indikatorer). I den slutgiltiga modellen tilläts fem residuala korrelationer, som samtliga förbättrade modellens χ^2 anpassning med åtminstone 50 poäng. Fem strukturella regressioner utfördes, en med hela samplet, två där det äldsta barnet undersöktes under två åldersintervall, och två där det nästäldsta barnet undersöktes under samma två åldersintervall. Åldersintervallen var 0 – 1 och 1 – 3. Resultaten av anlyserna sammanfattas i tabell 3. Resultaten visade en positiv association mellan spädbarns nattvaknande och mödrars sömnproblem för samtliga regressioner ($\beta = .84$; $\beta = .84$; $\beta = .78$; $\beta = .82$; $\beta = .81$). Vidare visade de en positiv association mellan mödrars sömnprobelm och postpartumdepression för de fem regressionerna ($\beta = .75$; $\beta = .74$; $\beta = .69$; $\beta = .78$; $\beta = .81$). Symtom på postpartumdepression associerades med längre tidsintervall mellan födslar för hela samplet och för det äldsta barnet under båda åldersintervallen ($\beta = .23$; $\beta = .23$; $\beta = .28$), men inte för det nästäldsta barnet. Mödrars sömnproblem associerades med kortare tidsintervall mellan födslar för hela samplet och för det äldsta barnet under båda åldersintervallen ($\beta = -.30$; $\beta = -.22$; $\beta = -.30$), men inte för det nästäldsta barnet.

Diskussion

I motsas till studiens ursprungliga hypotes upptäcktes att mödrars sömnproblem är associerat med kortare tidsintervall mellan födslar. Med andra ord indikerar detta att större

sömnproblem för modern associerars med kortare tidsintervall tills nästa syskon föds. Dessa resultat är inte i linje med hypotesen att moderns sömnbrist, på grund av barnets nattvaknande, associeras med längre tidsintervall mellan födslar och med symtom på postpartumdepression.

Resultaten visade dock en positiv association mellan symtom på postpartumdepression och mödrars sömnproblem för hela samplet och för båda barnen under båda åldersintervallen, samt att symtom på postpartumdepression är associerade med längre tidsintervall mellan födslar för hela samplet och för det äldsta barnet under båda åldersintervallen. Dessa resultat indikerar att symtom på postpartumdepression kan vara adaptivt ur spädbarnets perspektiv, eftersom de associeras med längre tidsintervall mellan födslar.

Att mödrars sömnproblem associeras med kortare tidsintervall mellan födslar kunde möjligen bero på mängden socialt stöd mödrarna har tillgång till. Tidigare forskning har hävdat att postpartumdepression kunde vara ett sätt en mor signalerar behov av ytterligare socialt stöd (Hagen, 1999). Med andra ord kunde ett spekulativt sätt att tolka resultaten på vara att mödrar som lider av sömnproblem men får tillräckligt med socialt stöd, är mindre benägna att utveckla symtom av postpartumdepression. I dessa fall, trots att de lider av sömnproblem, skaffar de det nästa barnet i snitt fortare, eftersom de upplever att de fått tillräckligt med stöd från omgivningen.

Slutligen indikerar resultaten att det finns en skillnad mellan mödrar till två barn och mödrar till tre eller fler barn. Associationerna mellan mödrars sömnproblem och längden på tidsintervallet mellan födslar samt mellan symtom på postpartumdepression och längden på tidsintervallet mellan födslar fanns endast för det äldsta barnet under båda åldersintervallen, men inte för det nästäldsta barnet under någotdera åldersintervall. Medelåldern för förstföderskor i Finland var år 2018 29,3 år (Terveyden ja hyvinvoinnin laitos; THL, 2020). En kvinnas fertilitet minskar markant från och med 32 års ålder (Committee on Gynecologic Practice of American College of Obstetricians and Gynecologists, & Practice Committee of American Society for Reproductive Medicine, 2008). Detta innebär att med tanke på den höga medelåldern för förstföderskor i Finland, är mödrar tvungna att skaffa barn i relativt snabb takt ifall de vill ha fler än två barn. En möjlig orsak till skillnaden mellan två barns mödrar och mödrar till tre eller fler barn kunde alltså tänkas vara att moderns kognitioner helt enkelt vinner över eventuella evolutionära drifter att förlänga intervallet mellan födslarna.

En styrka med denna studie var det stora samplet, som bestod av 729 mödrar. Samplets

storlek gjorde det möjligt för oss att analysera data med en SEM, en analysmetod som tar mätfel i beaktande (Tomarken & Waller, 2005). Denna studie har även vissa svagheter. Bland annat var samtliga frågeformulär som användes för att samla in data i denna studie retrospektiva, vilket ökar risken för att man under- eller överskattar symtom. Framtida forskning bör undersöka rollen socialt stöd spelar för att bättre förstå de faktorer som leder till att mödrars sömnproblem leder till kortare tidsintervall mellan födslar.

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Appendix

Table 1

Items Used to Measure Infant Night Waking

	Infant night waking	
Item name	Question	Response options
INW_1	How many times on average did your oldest child wake up per night during the first year?	Hardly ever; Once or twice per night; Three times per night; Four or five times per night; More than five times per night
INW_2	How well did your oldest child sleep during the first year?	Very well; Well; Okay; Poorly; Very poorly
INW_3	How difficult was it to get your oldest child to sleep through the night during the first year?	Very easy; Easy; Moderate; Hard; Very hard
INW_1_1-3	How many times on average did your oldest child wake up per night between age 1 – 3?	Hardly ever; Once or twice per night; Three times per night; Four or five times per night; More than five times per night
INW_2_1-3	How well did your oldest child sleep during age 1 – 3?	Very well; Well; Okay; Poorly; Very poorly
INW_3_1-3	How difficult was it to get your oldest child to sleep through the night during age 1 – 3?	Very easy; Easy; Moderate; Hard; Very hard
2INW_1	How many times on average did your second oldest child wake up per night during the first year?	Hardly ever; Once or twice per night; Three times per night; Four or five times per night; More than five times per night
2INW_2	How well did your second oldest child sleep during the first year?	Very well; Well; Okay; Poorly; Very poorly
2INW_3	How difficult was it to get your second oldest child to sleep through the night during the first year?	Very easy; Easy; Moderate; Hard; Very hard
2INW_1_1-3	How many times on average did your second oldest child wake up per night between age 1 – 3?	Hardly ever; Once or twice per night; Three times per night; Four or five times per night; More than five times per night
2INW_2_1-3	How well did your second oldest child sleep during age 1 – 3?	Very well; Well; Okay; Poorly; Very poorly
2INW_3_1-3	How difficult was it to get your second oldest child to sleep through the night during age 1 – 3?	Very easy; Easy; Moderate; Hard; Very hard

Note: INW = Infant night waking. The number following the abbreviation stands for the item in question. The sequence 1 – 3 signifies the second, studied, age interval, when the child was 1 – 3 years old. The number two, preceding the abbreviation signifies that the item is used to measure the second oldest child.

Table 2

Items Used to Measure Maternal Sleep Disturbance

	Maternal Sleep Disruption	
Item name	Question	Response options
MSD_1	How many hours on average did you sleep per night during your oldest child's first year?	Numerical input
ISI_1	Please rate the severity of your insomnia problem(s) during your oldest child's first year: Difficulty falling asleep	None; Mild; Moderate; Severe; Very Severe
ISI_2	Please rate the severity of your insomnia problem(s) during your oldest child's first year: Difficulty staying asleep	None; Mild; Moderate; Severe; Very Severe
ISI_3	Please rate the severity of your insomnia problem(s) during your oldest child's first year: Problem waking up too early	None; Mild; Moderate; Severe; Very Severe
ISI_4	How satisfied/dissatisfied were you with your sleep pattern during your oldest child's first year?	Very satisfied; Satisfied; Neither satisfied nor dissatisfied; Dissatisfied; Very dissatisfied
ISI_5	To what extent did your sleep problem during your oldest child's first year interfere with your daily functioning (e.g. daytime fatigue, ability to function at work/daytime chores, memory, mood etc.)?	Not at all interfering; A little; Somewhat; Much; Very much interfering
ISI_6	How noticeable to others do you think your sleeping problem was during your oldest child's first year in terms of impairing the quality of your life?	Not at all noticeable; Barely; Somewhat; Much; Very much noticeable
ISI_7	How worried/distressed were you about your sleep problem during your oldest child's first year?	Not at all; A little; Somewhat; Much; Very much
MSD_1_1-3	How many hours on average did you sleep per night when your oldest child was 1 – 3 years old?	Numerical input
ISI_1_1-3	Please rate the severity of your insomnia problem(s) when your oldest child was 1 – 3 years old: Difficulty falling asleep	None; Mild; Moderate; Severe; Very Severe

ISI_2_1-3	Please rate the severity of your insomnia problem(s) when your oldest child was 1 – 3 years old: Difficulty staying asleep	None; Mild; Moderate; Severe; Very Severe
ISI_3_1-3	Please rate the severity of your insomnia problem(s) when your oldest child was 1 – 3 years old: Problem waking up too early	None; Mild; Moderate; Severe; Very Severe
ISI_4_1-3	How satisfied/dissatisfied were you with your sleep pattern when you oldest child was 1 – 3 years old?	Very satisfied; Satisfied; Neither satisfied nor dissatisfied; Dissatisfied; Very dissatisfied
ISI_5_1-3	To what extent did your sleep problem when your oldest child was 1 – 3 years old interfere with your daily functioning (e.g. daytime fatigue, ability to function at work/daytime chores, memory, mood etc.)?	Not at all interfering; A little; Somewhat; Much; Very much interfering
ISI_6_1-3	How noticeable to others do you think your sleeping problem was when your oldest child was 1 – 3 years old in terms of impairing the quality of your life?	Not at all noticeable; Barely; Somewhat; Much; Very much noticeable
ISI_7_1-3	How worried/distressed were you about your sleep problem when your oldest child was 1 – 3 years old?	Not at all; A little; Somewhat; Much; Very much
2MSD_1	How many hours on average did you sleep per night during your second oldest child's first year?	Numerical input
2ISI_1	Please rate the severity of your insomnia problem(s) during your second oldest child's first year: Difficulty falling asleep	None; Mild; Moderate; Severe; Very Severe
2ISI_2	Please rate the severity of your insomnia problem(s) during your second oldest child's first year: Difficulty staying asleep	None; Mild; Moderate; Severe; Very Severe
2ISI_3	Please rate the severity of your insomnia problem(s) during your second oldest child's first year: Problem waking up too early	None; Mild; Moderate; Severe; Very Severe
2ISI_4	How satisfied/dissatisfied were you with your sleep pattern during your second oldest child's first year?	Very satisfied; Satisfied; Neither satisfied nor dissatisfied; Dissatisfied; Very dissatisfied

2ISI_5	To what extent did your sleep problem during your second oldest child's first year interfere with your daily functioning (e.g. daytime fatigue, ability to function at work/daytime chores, memory, mood etc.)?	Not at all interfering; A little; Somewhat; Much; Very much interfering
2ISI_6	How noticeable to others do you think your sleeping problem was during your second oldest child's first year in terms of impairing the quality of your life?	Not at all noticeable; Barely; Somewhat; Much; Very much noticeable
2ISI_7	How worried/distressed were you about your sleep problem during your second oldest child's first year?	Not at all; A little; Somewhat; Much; Very much
2MSD_1_1-3	How many hours on average did you sleep per night when your second oldest child was 1 – 3 years old?	Numerical input
2ISI_1_1-3	Please rate the severity of your insomnia problem(s) when your second oldest child was 1 – 3 years old: Difficulty falling asleep	None; Mild; Moderate; Severe; Very Severe
2ISI_2_1-3	Please rate the severity of your insomnia problem(s) when your second oldest child was 1 – 3 years old: Difficulty staying asleep	None; Mild; Moderate; Severe; Very Severe
2ISI_3_1-3	Please rate the severity of your insomnia problem(s) when your second oldest child was 1 – 3 years old: Problem waking up too early	None; Mild; Moderate; Severe; Very Severe
2ISI_4_1-3	How satisfied/dissatisfied were you with your sleep pattern when your second oldest child was 1 – 3 years old?	Very satisfied; Satisfied; Neither satisfied nor dissatisfied; Dissatisfied; Very dissatisfied
2ISI_5_1-3	To what extent did your sleep problem when your second oldest child was 1 – 3 years old interfere with your daily functioning (e.g. daytime fatigue, ability to function at work/daytime chores, memory, mood etc.)?	Not at all interfering; A little; Somewhat; Much; Very much interfering

2ISI_6_1-3	How noticeable to others do you think your sleeping problem was when your second oldest child was 1 – 3 years old in terms of impairing the quality of your life?	Not at all noticeable; Barely; Somewhat; Much; Very much noticeable
2ISI_7_1-3	How worried/distressed were you about your sleep problem when your second oldest child was 1 – 3 years old?	Not at all; A little; Somewhat; Much; Very much

Note: MSD = Maternal sleep disturbance. ISI = Insomnia severity index (Morin, 1993). The number following the abbreviation stands for the item in question. The sequence 1 – 3 signifies the second, studied age interval, when the child was 1 – 3 years old. The number two, preceding the abbreviation signifies that the item is used to measure the second oldest child.

Table 3

Items Used to Measure Symptoms of Postpartum Depression

Symptoms of Postpartum Depression		
Item name	Question	Response options
EPDS_1	During your oldest child's first year, were you able to laugh and see the funny side of things?	As much as I always could; not quite so much; Definitely not so much; Not at all
EPDS_2	During your oldest child's first year, were you able to look forward with enjoyment to things?	As much as I always could; Rather less than I used to; Definitely less than I used to; hardly at all
EPDS_3	During your oldest child's first year, were things getting on top of you?	Yes, much of the time I wasn't coping as well as usual; Yes sometimes I wasn't coping as well as usual; No, most of the time I was coping quite well; No, I was coping as well as ever
EPDS_4	During your oldest child's first year, were you so unhappy you had difficulty sleeping?	Yes, most of the time; Yes, sometimes; Not very often; No, not at all
EPDS_5	During your oldest child's first year, were you feeling sad or miserable	Yes, most of the time; Yes, quite often; Not very often; No, not at all
EPDS_6	During your oldest child's first year, were you so unhappy that you were crying?	Yes, most of the time; Yes, quite often; Only occasionally; No, never

EPDS_7	During your oldest child's first year, did the thought of harming yourself occur to you?	Yes, quite often; Sometimes; Hardly ever; Never
EPDS_1_1-3	When your oldest child was 1 – 3 years old, were you able to laugh and see the funny side of things?	As much as I always could; not quite so much; Definitely not so much; Not at all
EPDS_2_1-3	when your oldest child was 1 – 3 years old, were you able to look forward with enjoyment to things?	As much as I always could; Rather less than I used to; Definitely less than I used to; hardly at all
EPDS_3_1-3	When your oldest child was 1 – 3 years old, were things getting on top of you?	Yes, much of the time I wasn't coping as well as usual; Yes sometimes I wasn't coping as well as usual; No, most of the time I was coping quite well; No, I was coping as well as ever
EPDS_4_1-3	When your oldest child was 1 – 3 years old, were you so unhappy you had difficulty sleeping?	Yes, most of the time; Yes, sometimes; Not very often; No, not at all
EPDS_5_1-3	When your oldest child was 1 – 3 years old, were you feeling sad or miserable?	Yes, most of the time; Yes, quite often; Not very often; No, not at all
EPDS_6_1-3	When your oldest child was 1 – 3 years old, were you so unhappy that you were crying?	Yes, most of the time; Yes, quite often; Only occasionally; No, never
EPDS_7_1-3	When your oldest child was 1 – 3 years old, did the thought of harming yourself occur to you?	Yes, quite often; Sometimes; Hardly ever; Never
2EPDS_1	During your second oldest child's first year, were you able to laugh and see the funny side of things?	As much as I always could; not quite so much; Definitely not so much; Not at all
2EPDS_2	During your second oldest child's first year, were you able to look forward with enjoyment to things?	As much as I always could; Rather less than I used to; Definitely less than I used to; hardly at all
2EPDS_3	During your second oldest child's first year, were things getting on top of you?	Yes, much of the time I wasn't coping as well as usual; Yes sometimes I wasn't coping as well as usual; No, most of the time I was coping quite well; No, I was coping as well as ever
2EPDS_4	During your second oldest child's first year, were you so unhappy you had difficulty sleeping?	Yes, most of the time; Yes, sometimes; Not very often; No, not at all

2EPDS_5	During your second oldest child's first year, were you feeling sad or miserable?	Yes, most of the time; Yes, quite often; Not very often; No, not at all
2EPDS_6	During your second oldest child's first year, were you so unhappy that you were crying?	Yes, most of the time; Yes, quite often; Only occasionally; No, never
2EPDS_7	During your second oldest child's first year, did the thought of harming yourself occur to you?	Yes, quite often; Sometimes; Hardly ever; Never
2EPDS_1_1-3	When your second oldest child was 1 – 3 years old, were you able to laugh and see the funny side of things?	As much as I always could; not quite so much; Definitely not so much; Not at all
2EPDS_2_1-3	When your second oldest child was 1 – 3 years old, were you able to look forward with enjoyment to things?	As much as I always could; Rather less than I used to; Definitely less than I used to; hardly at all
2EPDS_3_1-3	When your second oldest child was 1 – 3 years old, were things getting on top of you?	Yes, much of the time I wasn't coping as well as usual; Yes sometimes I wasn't coping as well as usual; No, most of the time I was coping quite well; No, I was coping as well as ever
2EPDS_4_1-3	When your second oldest child was 1 – 3 years old, were you so unhappy you had difficulty sleeping?	Yes, most of the time; Yes, sometimes; Not very often; No, not at all
2EPDS_5_1-3	When your second oldest child was 1 – 3 years old, were you feeling sad or miserable?	Yes, most of the time; Yes, quite often; Not very often; No, not at all
2EPDS_6_1-3	When your second oldest child was 1 – 3 years old, were you so unhappy that you were crying?	Yes, most of the time; Yes, quite often; Only occasionally; No, never
2EPDS_7_1-3	When your second oldest child was 1 – 3 years old, did the thought of harming yourself occur to you?	Yes, quite often; Sometimes; Hardly ever; Never

Note: EPDS = Seven-item short version of the Edinburgh postnatal depression scale (Cox, 1987; Gollan, 2017). The number following the abbreviation stands for the item in question. The sequence 1 – 3 signifies the second, studied age interval, when the child was 1 – 3 years old. The number two, preceding the abbreviation signifies that the item is used to measure the second oldest child.

Table 4

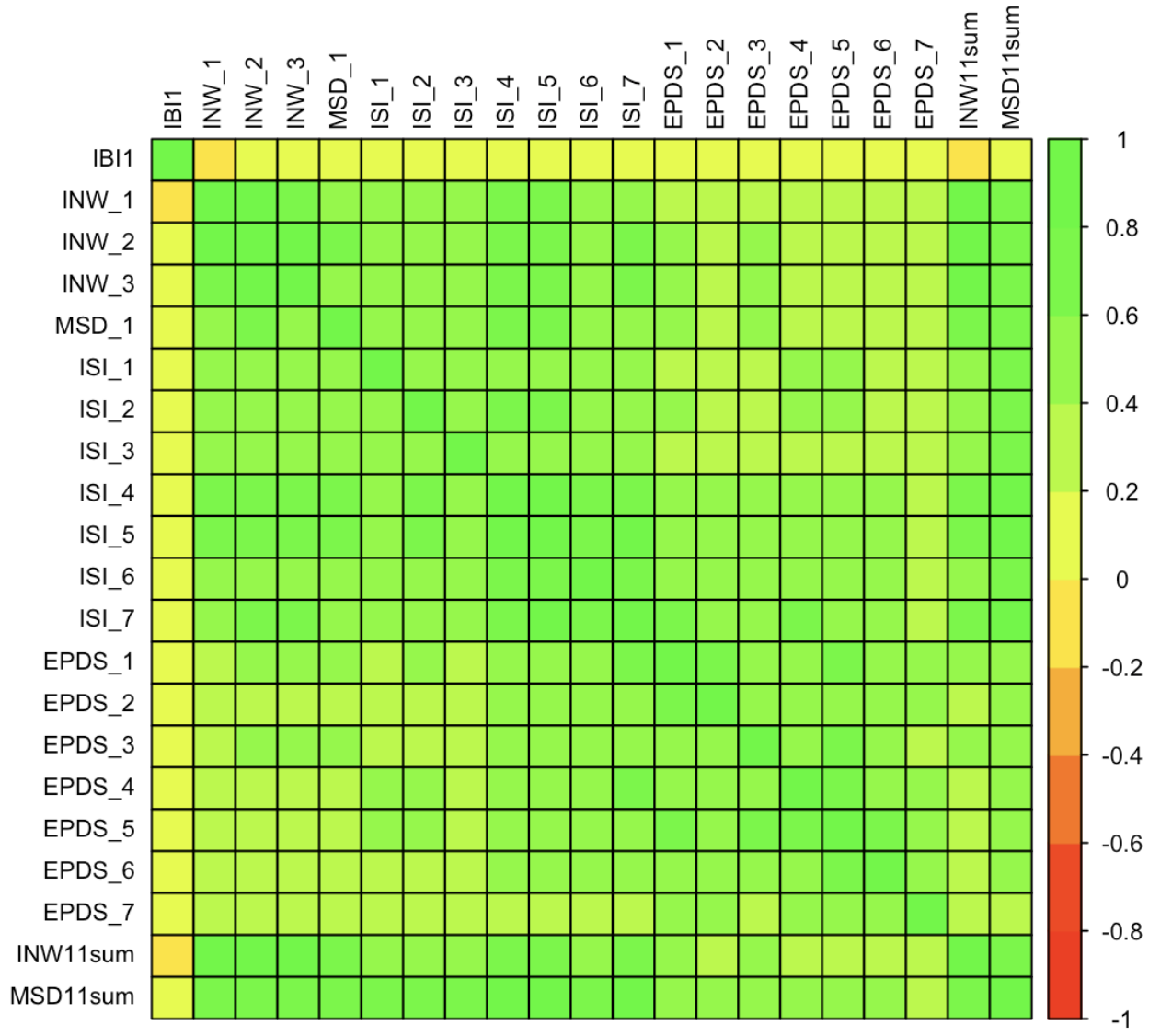
Results from the Winsorized Structural Regressions

	n			*b*	95% CI	*β*	SE	*z*	*p*
Full Sample	1429	INW	MSD	0.69	[0.66; 0.72]	.84	0.01	48.58	<.001
		MSD	PPD	0.92	[0.87; 0.96]	.75	0.02	38.14	<.001
		PPD	IBI	5.77	[2.94; 8.59]	.21	1.44	4.00	<.001
		MSD	IBI	-9.39	[-12.87; -5.92]	-.28	1.77	-5.29	<.001
Oldest child, 0 – 1	729	INW	MSD	0.69	[0.65; 0.73]	.84	0.02	33.69	<.001
		MSD	PPD	0.90	[0.83; 0.97]	.74	0.04	24.67	<.001
		PPD	IBI	5.62	[2.28; 8.96]	.23	1.70	3.27	.001
		MSD	IBI	-5.91	[-9.98; -1.84]	-.20	2.08	-2.85	.004
Oldest child, 1 – 3	267	INW	MSD	0.62	[0.55; 0.69]	.78	0.04	17.51	<.001
		MSD	PPD	0.83	[0.71; 0.96]	.69	0.06	12.97	<.001
		PPD	IBI	6.58	[1.60; 11.57]	.27	2.54	2.59	.010
		MSD	IBI	-9.16	[-15.37; -2.96]	-.31	3.16	-2.89	.004
Second child, 0 – 1	296	INW	MSD	0.68	[0.63; 0.74]	.82	0.03	23.41	<.001
		MSD	PPD	1.01	[0.91; 1.11]	.78	0.05	20.02	<.001
		PPD	IBI	-1.77	[-8.15; 4.61]	-.07	3.26	-0.54	.587
		MSD	IBI	2.89	[-5.12; 10.90]	.08	4.09	0.71	.479
Second child, 1 – 3	137	INW	MSD	0.56	[0.47; 0.65]	.81	0.05	12.32	<.001
		MSD	PPD	1.15	[0.98; 1.33]	.81	0.09	12.78	<.001
		PPD	IBI	3.87	[-4.44; 12.18]	.17	4.24	0.91	.361
		MSD	IBI	-4.89	[-16.71; 6.93]	-.15	6.03	-0.81	.418

Note. INW = Infant night waking. MSD = Maternal sleep disruption. PPD = Symptoms of postpartum depression. IBI = Interbirth interval. The numbers following the children in question represents the studied age interval. 0 – 1 = the first age interval, when the child was 0 – 1 years old. 1 – 3 = The second age interval, when the child was 1 – 3 years old.

Figure 1

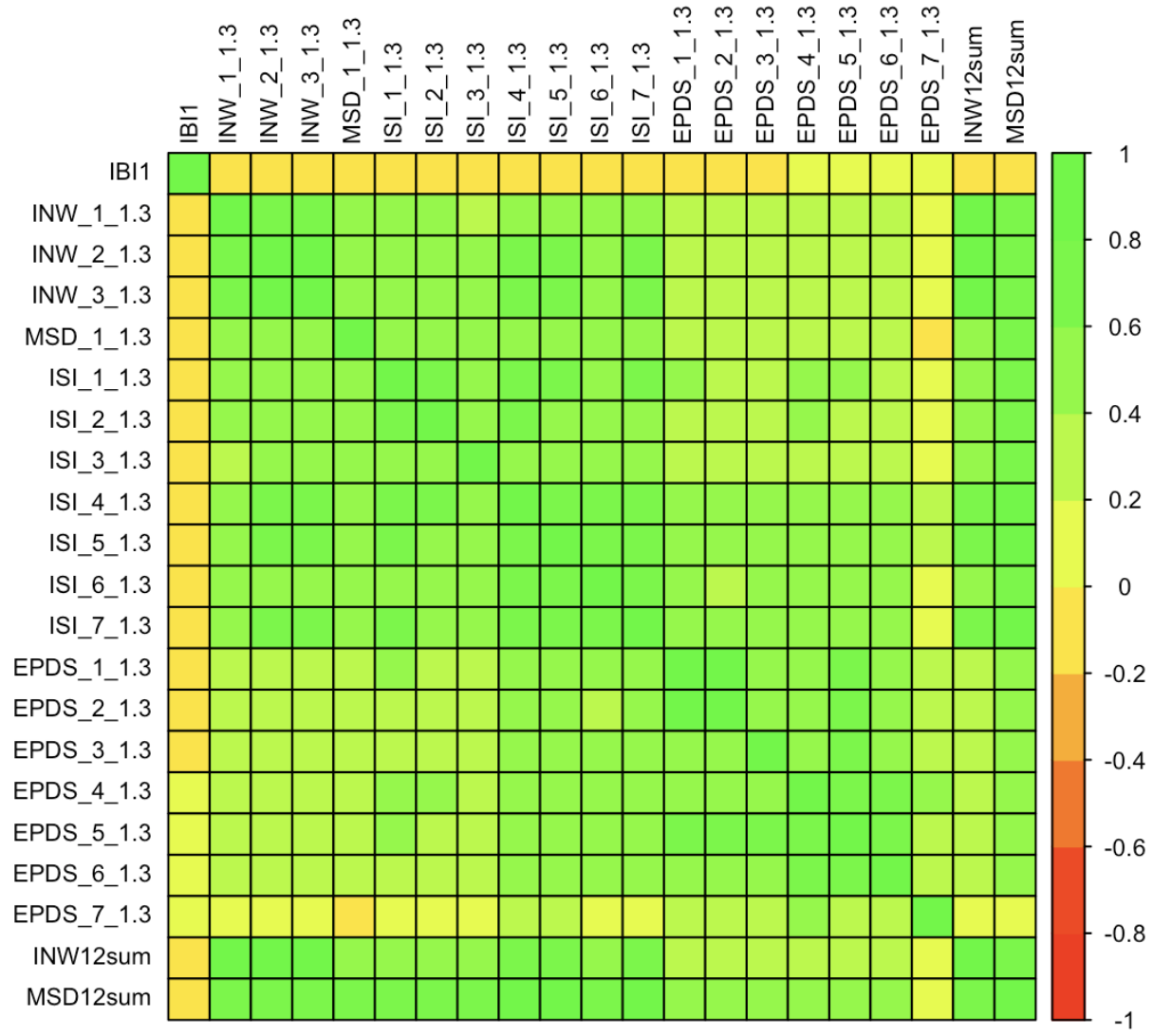
Correlations for Oldest Child during Age 0 – 1 Year



Note. IBI = Interbirth interval. INW = Infant night waking. MSD = Maternal sleep disruption. ISI = Insomnia severity index. EPDS = Edinburgh postnatal depression scale. The number following IBI represents the interbirth in question, 1 = The IBI between the oldest and second oldest child. The other numbers following the abbreviations stand for the item in question. Sum following the abbreviation represents the composite study variable in question.

Figure 2

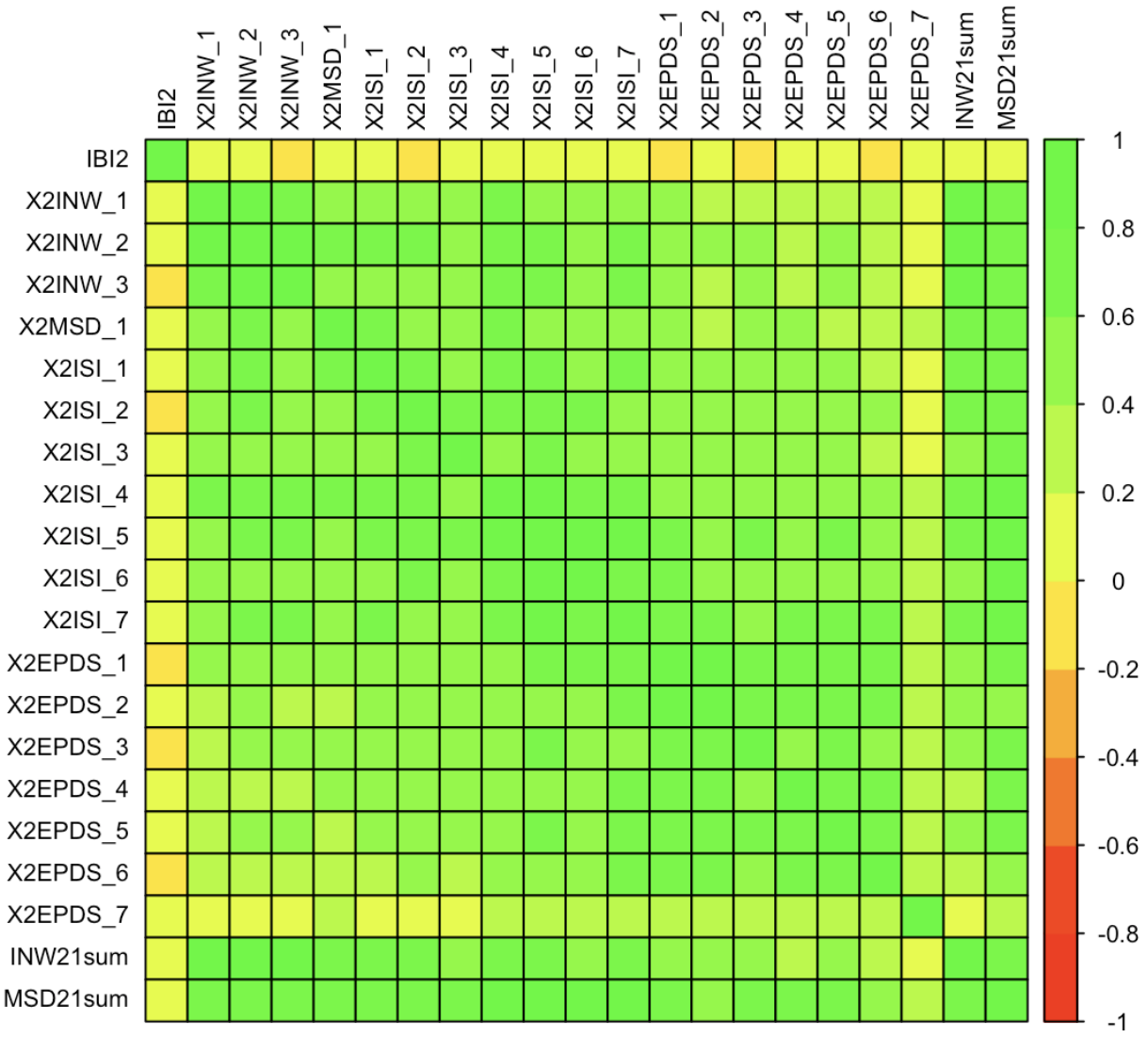
Correlations for Oldest Child during Age 1 – 3 Years



Note. IBI = Interbirth interval. INW = Infant night waking. MSD = Maternal sleep disruption. ISI = Insomnia severity index. EPDS = Edinburgh postnatal depression scale. The number following IBI represents the interbirth in question, 1 = The IBI between the oldest and second oldest child. The first number following the abbreviation stands for the item in question. 1.3 = The studied age interval, when the child was 1 – 3 years old. Sum following the abbreviation represents the composite study variable in question.

Figure 3

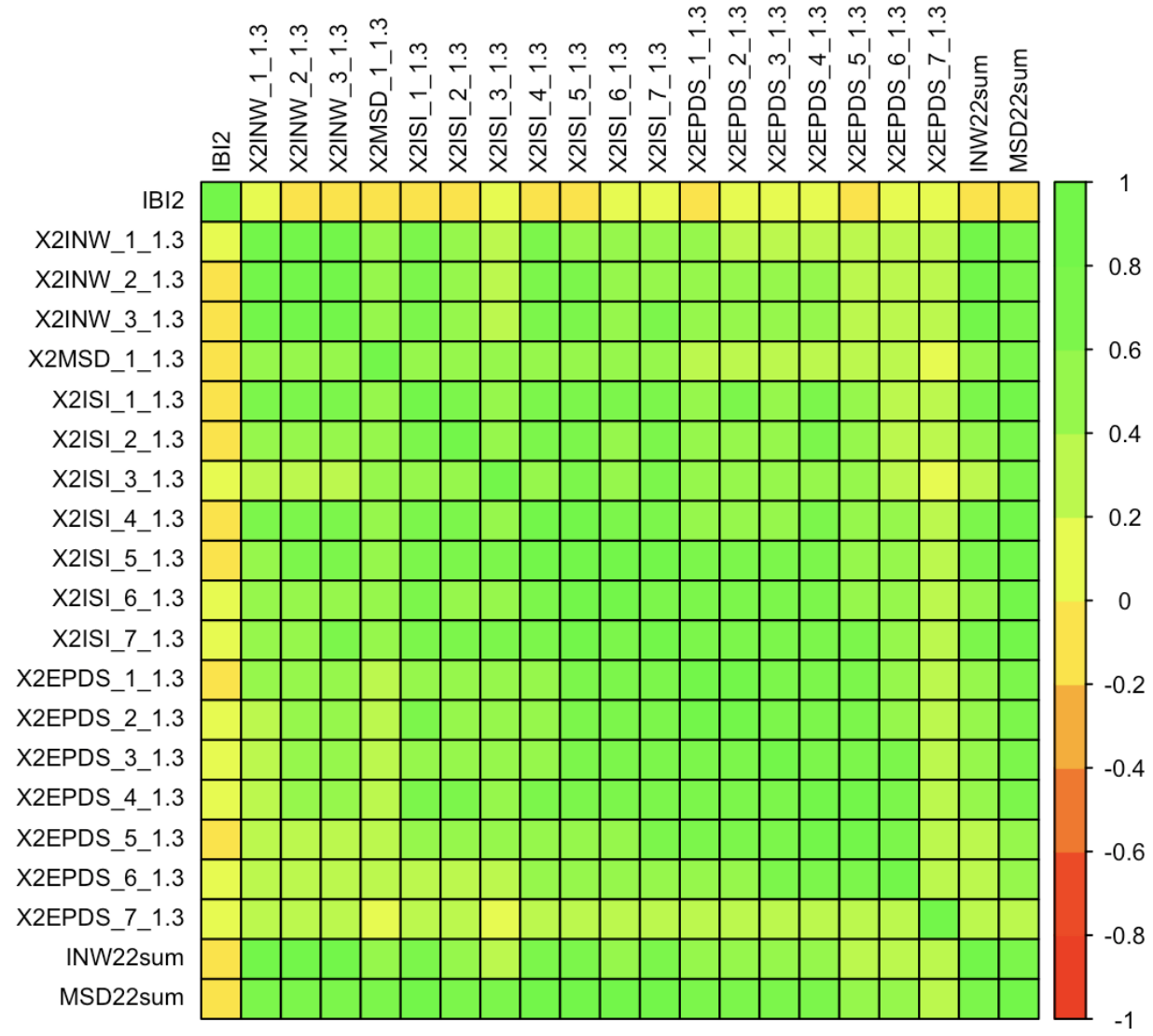
Correlations for Second Oldest Child during Age 0 – 1 Years



Note. IBI = Interbirth interval. INW = Infant night waking. MSD = Maternal sleep disruption. ISI = Insomnia severity index. EPDS = Edinburgh postnatal depression scale. The number following IBI represents the interbirth in question, 2 = The IBI between the second oldest and third oldest child. X2 = The second oldest child. The numbers following the abbreviations stand for the item in question. Sum following the abbreviation represents the composite study variable in question.

Figure 4

Correlations for Second Oldest Child during Age 1 – 3 Years



Note. IBI = Interbirth interval. INW = Infant night waking. MSD = Maternal sleep disruption. ISI = Insomnia severity index. EPDS = Edinburgh postnatal depression scale. The number following IBI represents the interbirth in question, 2 = The IBI between the second oldest and third oldest child. X2 = Represents the second oldest child. The numbers following the abbreviations stand for the item in question. 1.3 = The studied age interval, when the child was 1 – 3 years old. Sum following the abbreviation represents the composite study variable in question.

PRESSMEDDELANDE

Symptom på postpartumdepression uppvisar samband med längre tidsintervall mellan födslar

Pro-gradu avhandling i psykologi

Fakulteten för humaniora, psykologi och teologi, Åbo Akademi

Resultaten från en pro-gradu avhandling i psykologi vid Åbo Akademi tyder på att symtom på postpartumdepression ökar längden på tidsintervallet mellan födslar. Avhandlingen undersökte associationerna mellan spädbarns nattvaknande, mödrars sömnproblem, symptom på postpartumdepression och längden på tidsintervallet mellan födslar. Studien utfördes med hjälp av en nätenkät som fylldes i av 729 mödrar i åldrarna 22 – 60 år. Syftet med studien var att undersöka ifall mödrars sömnbrist, på grund av spädbarns nattvaknande, associeras med längre tidsintervall mellan födslar och symtom på postpartumdepression, samt ifall symtom på postpartumdepression medierar associationen mellan mödrars sömnbrist och längre tidsintervall mellan födslar. Studiens data bestod i stor del av svar från mödrar bosatta i Finland, något man bör ta i beaktande vid tolkning av resultaten. Avhandlingen är den första som undersöker associationerna mellan spädbarns nattvaknande, mödrars sömnproblem, symtom på postpartumdepression och längden på tidsintervallet mellan födslar ur ett evolutionspsykologiskt perspektiv.

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